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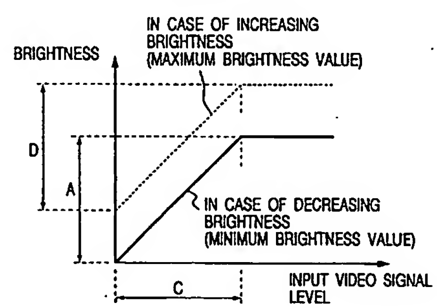
(54) Plasma display device and driving method

(57) An object according to the present invention is to provide a plasma display device capable of controlling the brightness of the entire image on a screen over a wide range without impairing a predetermined number of display gradation determined by a dynamic range for an A/D converter, an analogue input circuit and the like.

In order to achieve the above-described object, a plasma display device according to the present invention is provided with means for changing the discharge condition (number of discharge pulses, discharge voltage, discharge voltage waveform and the like) for primary discharging, which is effected for initialization, on selecting pixels in accordance with the brightness control to control the brightness of light emission due to priming discharging for controlling the brightness without impairing the number of display gradation.

FIG. 9



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Description

BACKGROUND OF THE INVENTION

The present invention relates to a plasma display device, and more particularly to a plasma display device provided with means for enabling an image to be variable density displayed at a predetermined number of display gradation on a screen in advance, and enabling brightness control for the entire image without impairing the predetermined number of display gradation. It relates to a plasma display device for displaying an image on the screen by controlling brightness tone by means of, for example, a time sharing drive method, and selectively radiating pixels arranged in a matrix shape, and a method of driving the device.

As a matrix type plasma display device provided with means for enabling brightness control, the description will be made of the prior art by exemplifying the plasma display device shown in the block diagram of Fig.2 hereinafter.

Fig.2 is a block diagram for a plasma display device for explaining conventional brightness control, and a plasma display panel (PDP) has a structure called "AC type". The plasma display device is composed of an analogue input circuit 10 in which an analogue video signal is inputted, an AD converter 11, a data writing processing circuit 12, a frame memory 13, a data reading processing circuit 14, a display control circuit 15, a brightness control circuit 16, a plasma display panel 21, an address pulse output circuit 22 for driving an address electrode 26, a scanning electrode 27, and a sustaining electrode 28 which the plasma display panel 21 has, a scanning pulse output circuit 23 (used for both scanning and sustaining, but hereinafter, referred to as scanning pulse output circuit), and a sustaining pulse output circuit 25.

An analogue video signal inputted is converted into digital data by the A/D converter 11, thereafter is written in the frame memory 13 through the data writing processing circuit 12. The data read out from the frame memory 13 are inputted into the address pulse output circuit 22 through the data reading processing circuit 14. The data converted into a plurality of bits by the A/D converter 11 are stored and processed with each bit in parallel when they are written in the frame memory 13, and are re-ordered in a single bit at a time, in units of so-called bit frames for being processed when they are read out from the frame memory 13. Each bit is allocated to each sub-field in accordance with the weighting of brightness.

A pulse signal supplied to the address pulse output circuit 22, the scanning pulse output circuit 23 and the sustaining pulse output circuit 25 is produced by the display control circuit 15 on the basis of a vertical synchronizing signal.

The brightness for the entire screen is controlled by controlling the analogue input circuit 10 by the brightness control circuit 16.

The plasma display panel 21 has two sheets of glass plates, an address electrode 26, a scanning electrode 27, a sustaining electrode 28, barrier ribs for partitioning the space sandwiched between the glass plates, and the like. The pixel consists of a discharge cell which is the space sandwiched between two sheets of glass plates and partitioned by a barrier rib.

The AC type is characterized in that the scanning electrode 27 and the sustaining electrode 28 are covered with dielectric layers. The discharge cell is charged with rare gas such as, for example, He-Xe and Ne-Xe, and when voltage is applied between any pair of the address electrodes 26, scanning electrodes 27 and sustaining electrodes 28, discharging occurs, generating ultraviolet rays. The barrier ribs are coated with phosphor, and are excited by ultraviolet rays to emit light. Color display can be performed by classifying luminous colors of phosphor into red, green and blue for each discharging cell for coating to select in accordance with the image signal.

Fig.3 shows an AC type plasma display drive waveform.

The electrode is driven in line sequence, and address pulses 51 at voltage VA are sequentially transmitted to address electrodes corresponding to the discharging cells of Nth row in response to the image signal. On the other hand, scanning pulses 52 at voltage VS are transmitted to the scanning electrodes sequentially from the 1st line. In a cell for which the address voltage VA and the scanning voltage VS have been applied at the same time, the voltage between electrodes exceeds a discharge starting voltage for discharging. This discharging is regarded as address discharging.

In order to stabilize the address discharging, a primary discharging period is usually provided before address discharging, such a voltage waveform as shown in Fig.3 is furnished to each electrode, and all cells are turned off after they are lighted by discharging for a moment simultaneously to furnish a predetermined charge (hereinafter, referred to as wall charge) on the dielectric layer for covering the electrode for initializing all the cells.

In a cell in which discharging has occurred, charges are accumulated on a dielectric layer for covering the electrode, and discharging can be generated again at a lower voltage than the discharge starting voltage if within a predetermined period thereafter. Such a driving method is called a "Memory driving method".

A time sharing drive method (hereinafter referred to as sub-field method) using this memory driving method will be described. The sub-field method is to divide one field into a plurality of sub-fields on which weighting has been effected in accordance with differences in luminous brightness and to select any sub-field for each pixel in response to the magnitude of the signal to thereby realize multi-tone display.

A drive sequence based on the time sharing drive method (sub-field method) of Fig.4 shows an example

of a case where sixteen tones are displayed by means of four sub-fields SF1 to SF4. The scanning period (is called address period as well) 61 represents a period to select a luminescent cell for the first sub-field, and the sustaining period 62 represents a period in which the cell selected emits light because of discharging between electrodes 27 and 28. The scanning period 61 includes the priming discharging period 63 and a period required to actually determine the address and select the luminescent cell. The priming discharging period 63 is a period required to initialize all the cells by first furnishing a predetermined wall charge on the electrodes on the entire screen.

The sustaining periods for sub-fields SF1 to SF4 are obtained by effecting weighting on the brightness ratio of 8 : 4 : 2 : 1, and if these sub-fields are arbitrarily selected in response to the level of a video signal, multi-tone display of fourth power of 2 = 16 tones becomes possible. If the number of display gradation should be increased, the number of sub-fields can be increased, and if the number of sub-fields is, for example, 8, 256 tones can be displayed. The brightness level of each sub-field is controlled by the number of pulses.

The time sharing drive method characterized in that the scanning period 61 and the sustaining period 62 are thus completely separated from each other and a driving pulse common to all the screens is furnished concerning the sustaining period is called "Address display period separated driving method". As regards devices using a time sharing drive method of this sort, refer to, for example, SHINGAKU GIHOU EID92-86(1993-01, pp7-11), etc.

SUMMARY OF THE INVENTION

In such a plasma display device of multi-tone display, brightness control (usually black level, which is the minimum brightness on the screen, is controlled) for an image on the entire screen has conventionally been performed by changing the DC level of an analogue video signal to be displayed in the analogue input circuit 10 by means of the brightness control circuit 16 as shown in, for example, Fig.2 and Fig.5 for an analogue video signal by brightness control. In other words, as regards the DC level of an analogue video signal to be inputted in the A/D converter 11 by brightness control, the black level moves up and down from a state a of brightness minimum to a state b of brightness maximum as shown in Fig.5.

In this way, the brightness has normally been controlled by controlling the DC level of the video signal conventionally. In the case of driving in multi-tone display, however, when the DC level of the video signal is controlled, there arises a problem that the effective number of display gradation is impaired by the brightness control.

The description will be made of this problem by exemplifying a case where multi-tone display is effected by pulse number modulation, using an explanatory view for showing a dynamic range by conventional brightness control of Fig. 6.

In order to effect the pulse number modulation, the video signal is converted into a PCM signal by the A/D converter for use. When the DC level and amplitude of an input video signal to this A/D converter are controlled, the following occurs.

If the number of display gradation of a playback image displayed on a television screen is 256 tones, it can be generally considered to be sufficient in terms of image quality, and therefore, the description will be made with the A/D converter for use as an output of eight bits. When the input dynamic range of this A/D converter is fully utilized from the minimum level to the maximum level, a PCM signal effective from LSB (Least Significant Bit) of eight bits to MSB (Most Significant Bit) can be obtained, thus enabling 256 tones to be displayed.

Referring to Fig. 6, in such an optimum state, that is, when eight bits of the A/D converter are allocated to the entire amplitude variation range (C in Fig. 6) of the video signal, the input dynamic range of the A/D converter which had eight bits as shown by A in Fig.6 before the brightness is increased decreases to a state shown by B when the brightness is increased by changing the DC level.

Thus, when the video signal goes high, there arises a problem that it deviates from the input dynamic range to saturate the brightness, thus making it impossible to play back a normal screen.

If eight bits or less are allocated to C in Fig. 6, the number of display gradation of an image to be displayed decreases. The same applies to an amplifier and the like of an analogue input circuit having no room in the dynamic range.

In order to avoid this, if the input dynamic range for the A/D converter is caused to have a room corresponding to the DC level control range for a video signal and an A/D converter of high-bit number such as 10 bits and 12 bits is used, the number of bits of the A/D converter is to be increased, and this leads to a problem that the A/D converter does not only become expensive, but also the signal processing circuit becomes complicated with the increase in number of bits, and also the power consumption increases.

Further, decreased luminous brightness is also unavoidable due to the decreased sustaining period resulting from the increased scanning period.

An object according to the present invention is to provide a plasma display device having means capable of effecting the brightness control for the entire image on a screen in a wide range without impairing the predetermined number of display gradation determined by a dynamic range for an A/D converter, an analogue input circuit and the like.

In order to achieve the above-described object, according to the present invention, there is provided means for changing the discharging condition, in accordance with the brightness control, for primary dis-

charging which is effected for initialization before the pixels are selected, making it possible to control the brightness of light emission due to priming discharging irrespective of the input analogue circuit, and to control the brightness of the entire image on the screen.

As the discharging condition, it will suffice if the discharge voltage, the number of times of discharging (number of discharge pulses), the width of discharge pulse, discharge voltage waveform and the like to be applied to each electrode are controlled.

Further, as another means for achieving the above-described object, according to the present invention, in addition to a conventional sub-field for displaying in response to a video signal, there is provided, within one field, a period for causing all the cells exclusively used for brightness control to discharge, and there is also provided means for changing the discharging condition within a period for discharging these all cells in accordance with the amount of brightness control without depending upon the video signal level to change the amount of light emission caused by discharging within the period for discharging these all cells in accordance with the brightness control, thus making it possible to control the brightness of the entire screen.

As the discharging condition, it will suffice if the discharge voltage, the number of times of discharging (number of discharge pulses), the width of discharge period, the discharge voltage waveform and the like to be applied to each electrode likewise are controlled.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is a block diagram showing a plasma display device according to a first embodiment of the present invention.

Fig.2 is a block diagram showing a plasma display device for explaining conventional brightness control.

Fig.3 is a plasma display driving waveform view.

Fig.4 is an explanatory view for showing drive sequence based on a time shearing drive method.

Fig.5 is an explanatory view for showing an analogue video signal based on brightness control.

Fig.6 is an explanatory view for showing a dynamic range based on conventional brightness control.

Fig.7 is an explanatory view for showing drive waveform of plasma display according to the present invention.

Fig.8 is an explanatory view for showing drive sequence based on the time shearing drive method according to the present invention.

Fig.9 is an explanatory view for showing the dynamic range based on brightness control according to the present invention.

Fig.10 is an explanatory view for showing drive waveform of plasma display according to another embodiment.

Fig.11 is an explanatory view for showing drive sequence based on the time shearing drive method according to another embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The description will be made of an embodiment according to the present invention in detail with reference to the drawings.

Fig.1 is a block diagram showing a plasma display device according to a first embodiment of the present invention, and portions identical to those in the block diagram for a plasma display device for explaining the conventional brightness control of Fig.2 are designated by the identical reference numerals or symbols. The major difference from Fig.2 is that the brightness control circuit 18 is constructed so as to control the display control circuit 17.

A plasma display device according to the present invention is composed of an analogue input circuit 10 in which an analogue video signal is inputted, an A/D converter 11, a data writing processing circuit 12, a frame memory 13, a data reading processing circuit 14, a display control circuit 17, a brightness control circuit 18, a plasma display panel 21, an address pulse output circuit 22 for driving an address electrode 26, a scanning electrode 27, and a sustaining electrode 28 which the plasma display panel 21 has, a scanning pulse output circuit 23 and a sustaining pulse output circuit 25.

An analogue video signal inputted is converted into digital data by the A/D converter 11, thereafter is written in the frame memory 13 through the data writing processing circuit 12. The data read out from the frame memory 13 are inputted into the address pulse output circuit 22 through the data reading processing circuit 14. The data converted into a plurality of bits by the A/D converter 11 are processed with each bit in parallel when they are written in the frame memory 13, and are processed in a single bit at a time, in units of so-called bit frames for processing when they are read out from the frame memory 13. Each bit is allocated to each sub-field in accordance with the weighting of brightness.

A pulse signal supplied to the address pulse output circuit 22, the scanning pulse output circuit 23 and the sustaining pulse output circuit 25 is produced by the display control circuit 17 on the basis of a vertical synchronizing signal.

The brightness of black level on the entire screen is controlled by controlling the display control circuit 17, and not by only signal processing by the analogue input circuit from the brightness control circuit 18.

The plasma display panel 21 has two sheets of glass plates, the addressing electrode 26, the scanning electrode 27, the sustaining electrode 28, barrier ribs for partitioning the space sandwiched between the glass plates, and the like. It is the same as in Fig.1 in that the pixel consists of a discharging cell which is the space sandwiched between two sheets of glass plates and partitioned by barrier ribs.

Fig.7 shows an AC type plasma display drive waveform according to the present invention. The electrode is driven in line sequence, and address pulses 51 at

voltage VA are sequentially transmitted to addressing electrodes corresponding to the discharging cells of Nth row in response to the image signal in the scanning period. On the other hand, scanning pulses 54 at voltage VS are transmitted to the scanning electrodes sequentially from the 1st line. In a cell for which the address voltage VA and the scanning voltage VS have been applied at the same time, the voltage between electrodes exceeds the discharge starting voltage for discharging (address discharging).

In order to stabilize the address discharging, a primary.discharging period is provided before address discharging, such a voltage waveform as shown in Fig.7 is furnished to each electrode, and all cells are turned off after they are lighted by discharging once simultaneously to furnish a predetermined wall charge on a dielectric layer for covering the electrode for initializing all the cells.

According to the present invention, it is made possible to control the brightness of the entire image on the screen by positively utilizing the light emission by the priming discharging at this time and controlling the brightness of light emission in accordance with the brightness control.

Conventionally deteriorated contrast caused by priming discharging light has been a problem, but there are many cases where the brightness is actually increased for use when the external light is bright, and therefore, this priming discharging has been utilized to the contrary in the present invention.

More specifically, there is provided means for changing the discharging condition for the priming discharging which is effected for initialization before the pixels are selected to control the brightness of light emission caused by the priming discharging. In the present embodiment, Fig.7 shows a state in which priming discharging has been effected three times in the priming discharging period in the scanning period. For example, there can be conceived to make the number of times of priming discharging of each sub-field variable from 10 times to once, or to increase the number of times of priming discharging to the maximum number sequentially from an appropriate sub-field. Also, referring to Fig. 7, the same number of drive waveforms are repeatedly applied to each electrode during priming discharging, but one part of a single drive waveform may be repeatedly applied to only a specified electrode. The present embodiment is characterized by being able to digitally control the number of times of light emission in response to the brightness control.

Concretely, first a comparatively low voltage pulse (which maybe zero) is applied as VA to all addressing electrodes, and at the same time, a positive, high voltage pulse is applied to the sustaining electrode for lighting by discharging once. Thereafter, a positive, high voltage pulse is applied to the scanning electrode, and at the same time, a negative (or trailing) voltage pulse is applied to the sustaining electrode (zero at addressing electrode) to ensure erasing of the priming discharging. This is repeated for a number of times required thereafter. In this respect, the DC level of GND may be either zero or a state in which a predetermined bias is applied.

By means of the time shearing drive method (subfield method) using the memory driving method, one field is divided into a plurality of sub-fields on which weighting has been effected in terms of differences in luminous brightness, any sub-field is selected for each pixel in accordance with the amplitude of the signal, and a positive voltage pulse is alternately applied between the scanning electrode and the sustaining electrode during the sustaining period of Fig.7 in the same subfields in which addressing has been completed to control for multi-tone display.

A drive sequence based on the time sharing drive method (sub-field method) of Fig.8 shows an example of a case where sixteen tones are displayed by means of four sub-fields SF1 to SF4. The scanning period (address period) 65 represents a period required to select a luminescent cell for the first sub-field, and the sustaining period 66 represents a period in which the cell selected emits light. The scanning period 65 includes the priming discharging period 67 and an address (or scanning) period required to actually determine the address and select the luminescent cell.

The priming discharging period 67 is a period required to initialize all cells by first furnishing a predetermined wall charge on the entire screen at the same time.

The sustaining periods for sub-fields SF1 to SF4 are obtained by effecting weighting on the brightness ratio of 8 : 4 : 2 : 1, and if these sub-fields are arbitrarily selected in accordance with the level of a video signal, multi-tone display of fourth power of 2 = 16 tones becomes possible. If the number of display gradation should be increased, the number of sub-fields can be increased, and if the number of sub-fields is, for example, 8, display of 256 tones becomes possible. The brightness level of each sub-field is controlled by the number of pulses.

In the priming discharging period 67 in the scanning period 65 of Fig. 8, priming discharging is effected three times as shown in, for example, drive waveform of Fig.10, and this is performed at least one sub-field of each priming discharging period SF1, SF2, SF3 and SF4, thus obtaining an amount of light emission adapted to the brightness control. If the time interval of light emission for brightness control is made uniform by effecting it, for example, within only priming discharging periods SF1 and SF3, it is possible to obtain the effect that there can be suppressed the occurrence of pseudo-contour-shaped noise which may be visually recognized during display of animation together with time shearing driving.

By the use of the present invention, the priming discharging light enters a state in which it is raised by brightness control as shown in Fig.9, and therefore, the DC level of a signal inputted into the A/D converter remains unchanged, and the dynamic range D in the

analogue portion by the brightness control according to the present invention becomes the same as A of Fig.6, thus making it possible to control the brightness of the entire image on the screen over a wide range without impairing a predetermined number of display gradation determined by the dynamic range.

The foregoing is an example in which the numbers of times of discharging within respective priming discharging periods of SF1 to SF4 are simultaneously changed in response to brightness control, but the present invention is not limited thereto, but is applicable.

As a modified example of the above-described first embodiment, a second embodiment will be described.

As the second embodiment, it may be possible to change only the number of times of discharging within a specified, for example, the priming discharging period SF1 and to set others to only once (usual priming discharging), or to combine them appropriately.

As effect peculiar to a case of combination, it is possible to reduce flicker by concentratedly effecting priming discharging for brightness in a short period of, for example, the sustaining period, and the like.

The foregoing is an example of changing a number of pulses, and since it does not depend upon the input analogue circuit, there is the effect that the input dynamic range can be fully used and it becomes easy to effect digital control, to say nothing of the effect that the tone has not to be sacrificed.

As a third embodiment, in contrast to the above-described examples in which the number of times of discharging is changed, the pulse width applied to each electrode may be changed in accordance with the brightness control with the number of pulses as a fixed number (for example, one) in Fig.7, or the voltage value of the applied pulse may be changed in accordance with the brightness control. For example, the voltage applied to the sustaining electrode can be changed. In the case of changing the voltage value, there is the effect that the brightness can be controlled only by means of the analog system with the digital circuit as it is, to say nothing of the amount of control being able to be selected continuously in non-stages.

There are various discharging conditions and, for example, the waveform (in, for example, Fig.10, the shape of the slope shown is made steep or smooth by controlling the time constant of a circuit for generating a voltage pulse falling slope of the scanning electrode within a priming discharging period) of the priming discharging may be changed in accordance with the brightness control.

The foregoing is an example in which the discharging condition of priming discharging is changed in accordance with the brightness control, but a fourth embodiment different from it will be described using the drive sequence in another embodiment of Fig.11.

In order to control the brightness of the entire image on a screen without impairing a predetermined number of display gradation determined by a dynamic range of the A/D converter, the analogue input circuit or the like, there is provided behind SF4, in the figure, a period (dedicated area, brightness control period 75 in the figure) for discharging all cells for exclusively controlling the brightness in addition to a sub-field for displaying in response to the video signal within one field, there is provided means for changing discharging condition for a period (substantially brightness control period, strictly speaking, a portion except priming discharging period 76) for discharging these all cells in accordance with the brightness control, and the amount of light emission caused by discharging within a period for discharging all cells in accordance with the brightness control can be changed to thereby control the brightness of the entire screen. At this time, it is needless to say that the number of sustaining discharging pulses within the brightness control period may be made variable.

Within this brightness control period 75, no scanning period is required because all pixels can be selected. To this end, almost all periods are spent for sustaining discharging. Also, the priming discharging period 76 in the figure can be replaced with a simultaneous address period for all pixels to use a single pulse etc. Further, a discharging pulse exceeding the discharge starting voltage can be used within a period for sustaining discharging within the brightness control period, and the number of the pulses can be made variable to thereby delete the priming discharging period 76.

As the discharging condition, it will suffice if the number of times of discharging (number of discharging pulses), width of discharging pulse, discharge voltage, discharge voltage waveform and the like within a period corresponding to the sustaining period within the brightness control period, to be applied to each electrode likewise are controlled.

In this case, video signal areas (SF1 to SF4) for display are not used, but control can be performed independently exclusively for brightness, and therefore, it becomes easy to design control circuits and the like.

Various embodiments have been described above, and these can be appropriately combined for use as a matter of course.

In a matrix display type plasma display device for selecting a number of pixels arranged in the horizontal and vertical directions for emitting light by applying voltage to a plurality of electrodes arranged in a matrix shape, the effect of the present invention is to be capable of controlling the brightness of the entire image on a screen over a wide range without impairing a predetermined number of display gradation determined by a dynamic range of the A/D converter, the analogue input circuit or the like by applying voltage to a plurality of electrodes arranged in a matrix shape.

Claims

1. A plasma display device of matrix display type for selecting a number of pixels arranged in the horizontal and vertical directions for emitting light by

applying voltage to a plurality of electrodes arranged in a matrix shape, having:

changing means for changing discharging condition for priming discharging which is effected for initialization in accordance with brightness control on selecting pixels, the offset amount of brightness level of the entire screen being controlled by changing an amount of light emission caused by priming discharging in accordance with brightness control.

2. A plasma display device as defined in Claim 1, wherein

said discharging condition is a number of times of priming discharging within a priming discharging period.

3. A plasma display device as defined in Claim 1, wherein

said changing means operates only within a priming discharging period for at least one subfield of a plurality of sub-fields.

4. A plasma display device as defined in Claim 1, wherein

said discharging condition is a voltage value for priming discharging pulse within said priming discharging period.

5. A plasma display device as defined in Claim 1, wherein

said discharging condition is a pulse width of said priming discharging pulse within said priming discharging period.

6. A plasma display device of matrix display type for selecting a number of pixels arranged in the horizontal and vertical directions for emitting light by applying voltage to a plurality of electrodes arranged in a matrix shape, there being, within one field, provided a period for

discharging all cells for exclusively controlling the brightness in addition to a sub-field for displaying in response to a video signal,
said device having means for changing a discharging condition within a period for discharging these all cells
in accordance with the brightness control, and the amount of light emission caused by discharging within a period for discharging all cells in accordance with the brightness control being changed to thereby control an offset amount of the brightness level of the entire screen.

7. A plasma display device as defined in Claim 6, wherein

said discharging condition is a number of times of discharging within a period for discharging all cells.

8. A matrix display type plasma display device comprising: a plurality of electrodes arranged in a matrix shape; a plurality of cells arranged at intersections of said plurality of electrodes; and a brightness control circuit for controlling a number of pulses, a magnitude of the pulse or the pulse width of voltage for driving said plurality of electrodes to change the luminous brightness of said plurality of cells,

means for controlling a discharging condition for priming discharging in accordance with the output of said brightness control circuit being provided to change an amount of light emission caused by priming discharging.

9. A method for driving a plasma display device of matrix display type for selecting a number of pixels arranged in the horizontal and vertical directions for emitting light by applying voltage to a plurality of electrodes arranged in a matrix shape,

before said pixels are selected, an amount of light emission caused by priming discharging being changed by controlling the discharging condition for priming discharging, which is effected for initialization, in accordance with brightness control.

10. A method for driving a plasma display device as defined in Claim 9, wherein said discharging condition is a number of times of priming discharging within a priming discharging period.

11. A method for driving a plasma display device as defined in Claim 9, wherein said changing means operates only within a priming discharging period in at least one sub-field of a plurality of sub-fields.

12. A method for driving a plasma display device as defined in Claim 9, wherein said discharging condition is a voltage value for priming discharging pulse within said priming discharging period.

13. A method for driving a plasma display device as defined in Claim 9, wherein said discharging condition is a pulse width for said priming discharging pulse within said priming discharging period.

FIG. 1

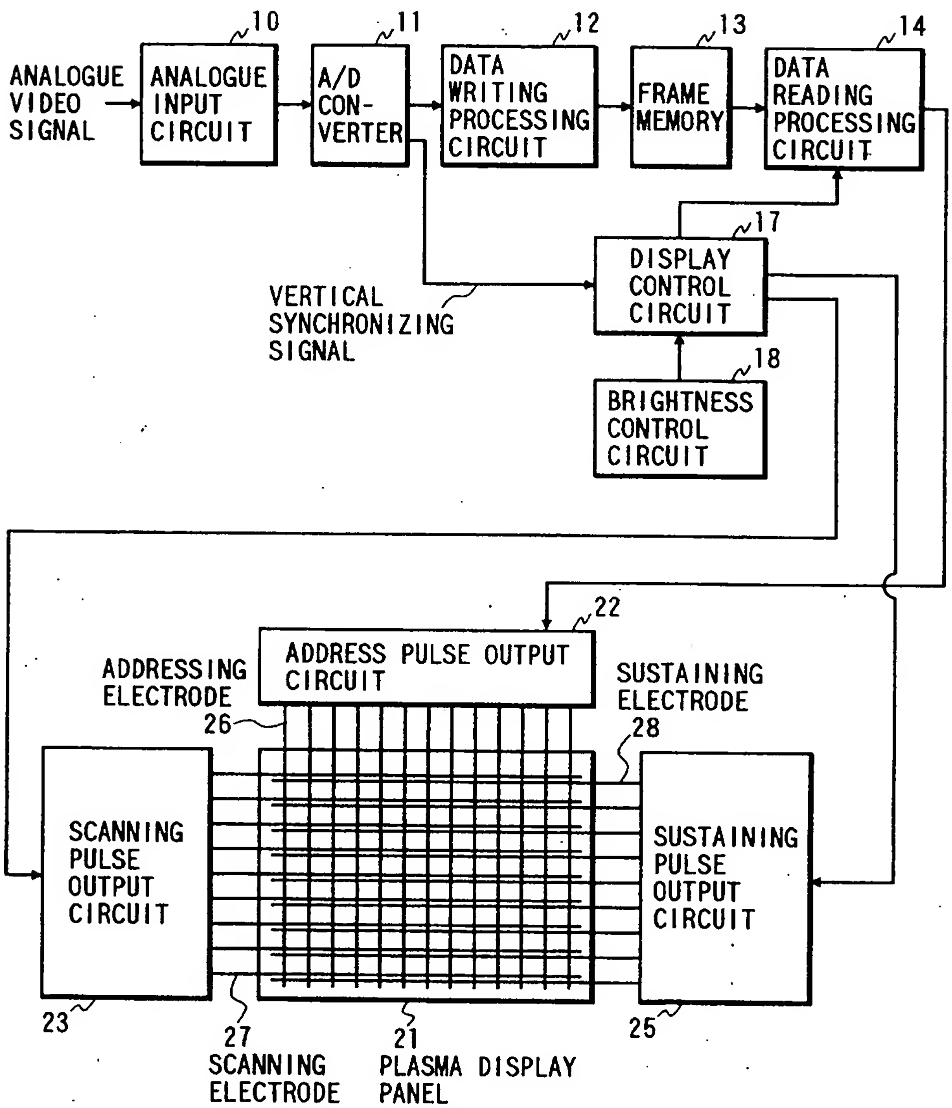
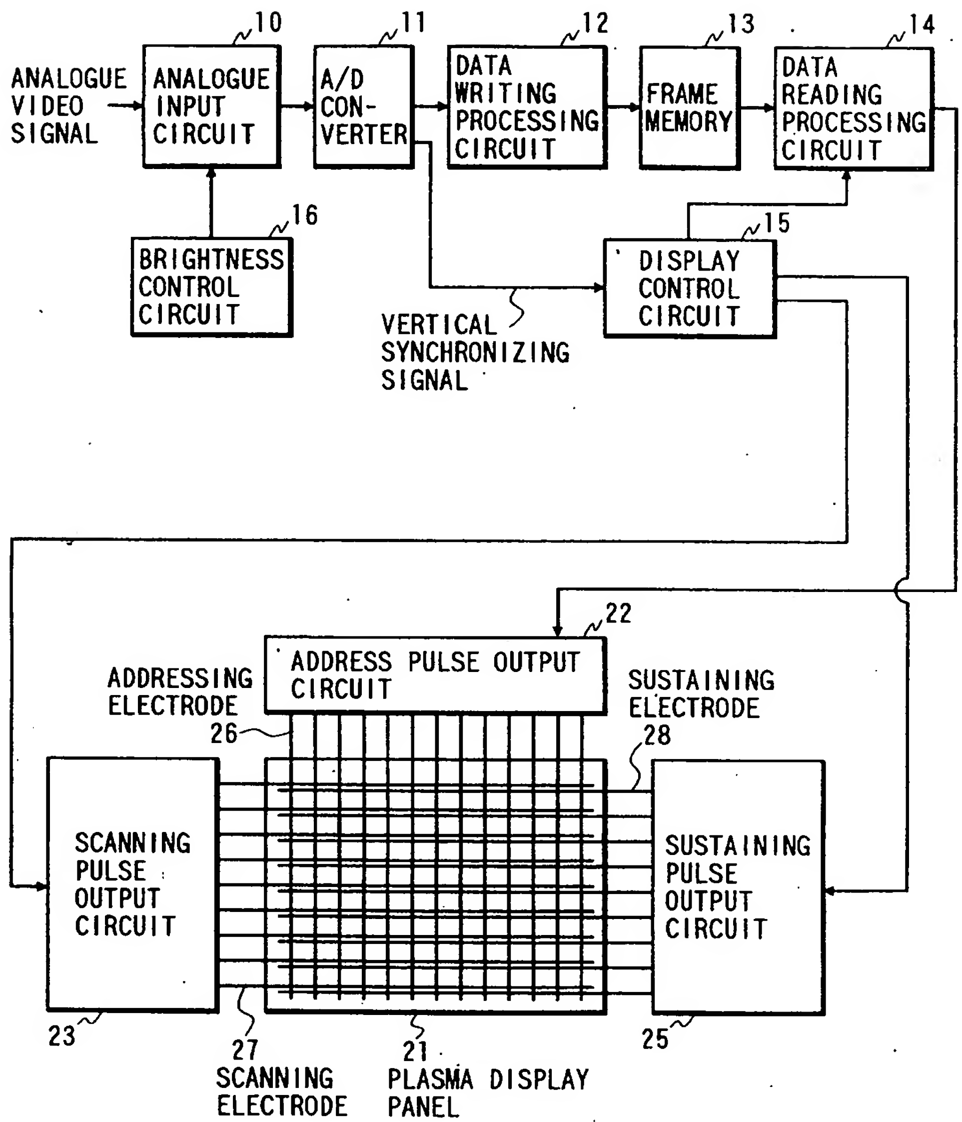

ANALOGUE VIDEO SIGNAL
ANALOGUE INPUT CIRCUIT
10
A/D CON-VERTER
11
DATA WRITING PROCESSING CIRCUIT
12
FRAME MEMORY
13
DATA READING PROCESSING CIRCUIT
14
DISPLAY CONTROL CIRCUIT
17
VERTICAL SYNCHRONIZING SIGNAL
BRIGHTNESS CONTROL CIRCUIT
18
ADDRESS PULSE OUTPUT CIRCUIT
22
ADDRESSING ELECTRODE
26
SUSTAINING ELECTRODE
28
SCANNING PULSE OUTPUT CIRCUIT
23
SUSTAINING PULSE OUTPUT CIRCUIT
25
27
SCANNING ELECTRODE
21
PLASMA DISPLAY PANEL

FIG. 2



ANALOGUE VIDEO SIGNAL
10
ANALOGUE INPUT CIRCUIT
11
A/D CON-VERTER
12
DATA WRITING PROCESSING CIRCUIT
13
FRAME MEMORY
14
DATA READING PROCESSING CIRCUIT
16
BRIGHTNESS CONTROL CIRCUIT
15
DISPLAY CONTROL CIRCUIT
VERTICAL SYNCHRONIZING SIGNAL
22
ADDRESS PULSE OUTPUT CIRCUIT
ADDRESSING ELECTRODE
26
SUSTAINING ELECTRODE
28
SCANNING PULSE OUTPUT CIRCUIT
SUSTAINING PULSE OUTPUT CIRCUIT
23
27
SCANNING ELECTRODE
21
PLASMA DISPLAY PANEL
25

FIG. 3

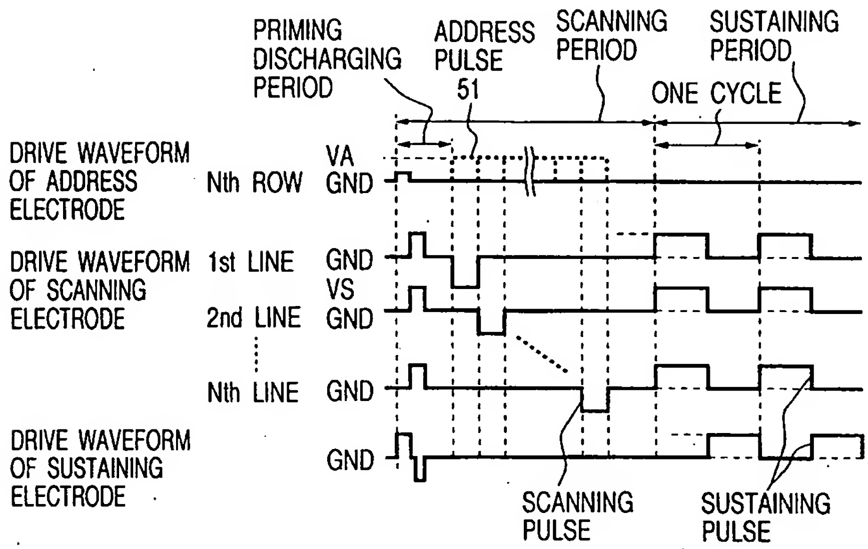

PRIMING
DISCHARGING
PERIOD
ADDRESS
PULSE
51
SCANNING
PERIOD
SUSTAINING
PERIOD
ONE CYCLE
DRIVE WAVEFORM
OF ADDRESS
ELECTRODE
Nth ROW
VA
GND
DRIVE WAVEFORM
OF SCANNING
ELECTRODE
1st LINE
GND
VS
2nd LINE
GND
Nth LINE
GND
DRIVE WAVEFORM
OF SUSTAINING
ELECTRODE
GND
SCANNING
PULSE
SUSTAINING
PULSE

FIG. 4

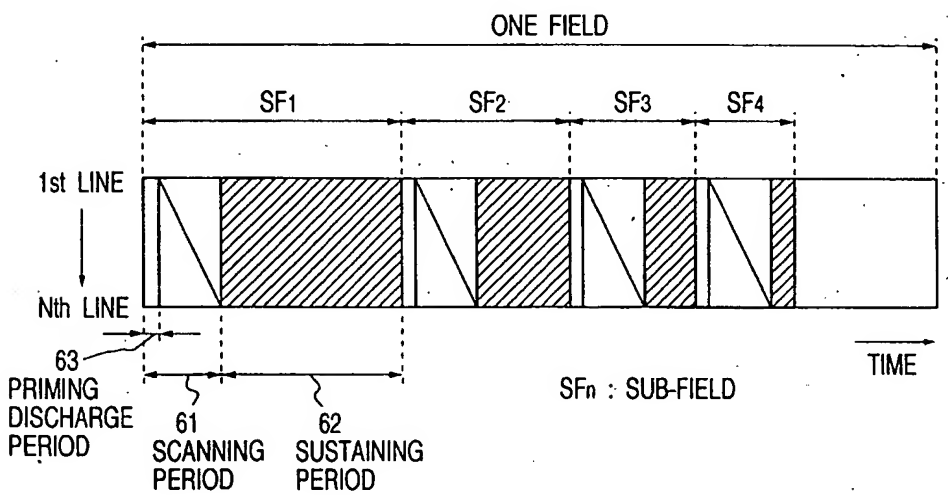

ONE FIELD
SF1
SF2
SF3
SF4
1st LINE
Nth LINE
63
PRIMING
DISCHARGE
PERIOD
61
SCANNING
PERIOD
62
SUSTAINING
PERIOD
SFn : SUB-FIELD
TIME

FIG. 5

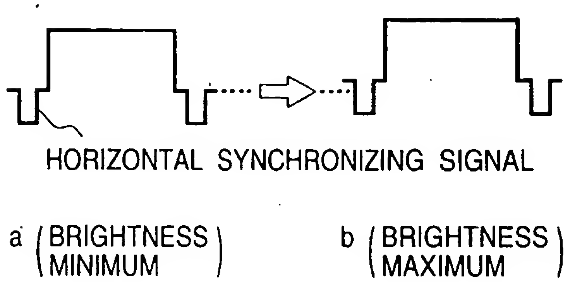

HORIZONTAL SYNCHRONIZING SIGNAL
a (BRIGHTNESS MINIMUM)
b (BRIGHTNESS MAXIMUM)

FIG. 6

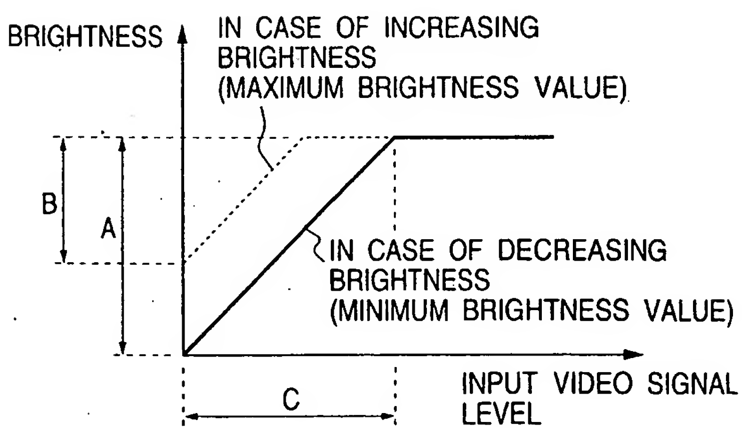

BRIGHTNESS
IN CASE OF INCREASING BRIGHTNESS (MAXIMUM BRIGHTNESS VALUE)
B
A
IN CASE OF DECREASING BRIGHTNESS (MINIMUM BRIGHTNESS VALUE)
C
INPUT VIDEO SIGNAL LEVEL

FIG. 7

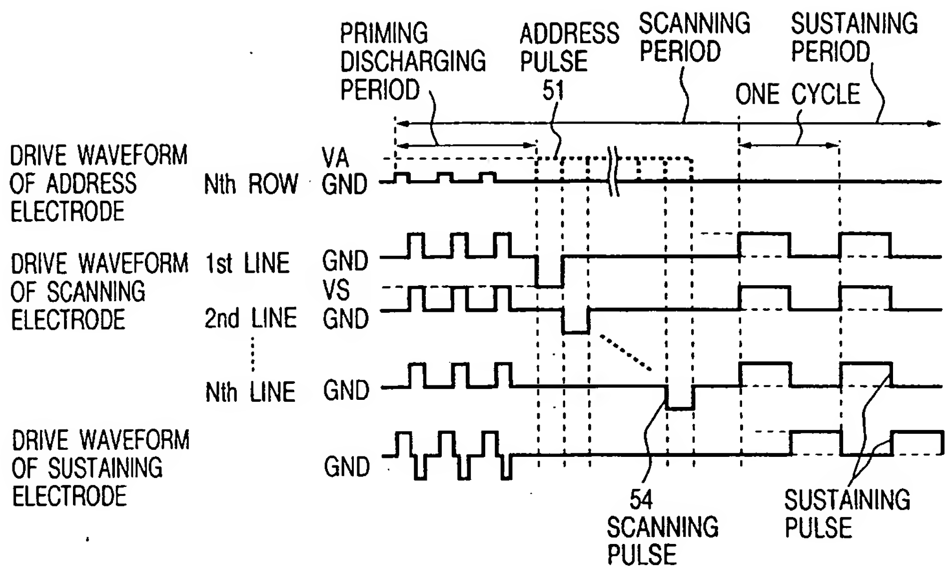

PRIMING
DISCHARGING
PERIOD
ADDRESS
PULSE
51
SCANNING
PERIOD
SUSTAINING
PERIOD
ONE CYCLE
DRIVE WAVEFORM
OF ADDRESS
ELECTRODE
Nth ROW
VA
GND
DRIVE WAVEFORM
OF SCANNING
ELECTRODE
1st LINE
GND
VS
2nd LINE
GND
Nth LINE
GND
DRIVE WAVEFORM
OF SUSTAINING
ELECTRODE
GND
54
SCANNING
PULSE
SUSTAINING
PULSE

FIG. 8

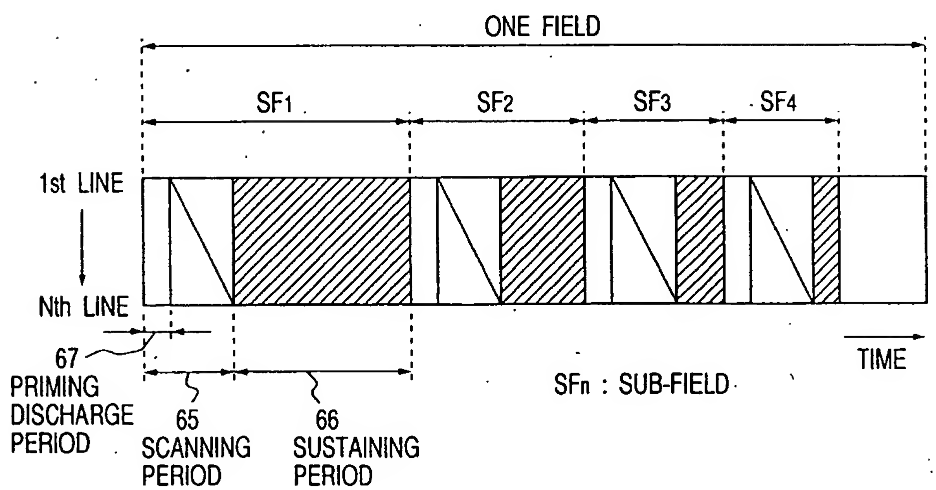

ONE FIELD
SF1
SF2
SF3
SF4
1st LINE
Nth LINE
67
PRIMING
DISCHARGE
PERIOD
65
SCANNING
PERIOD
66
SUSTAINING
PERIOD
TIME
SFn : SUB-FIELD

FIG. 9

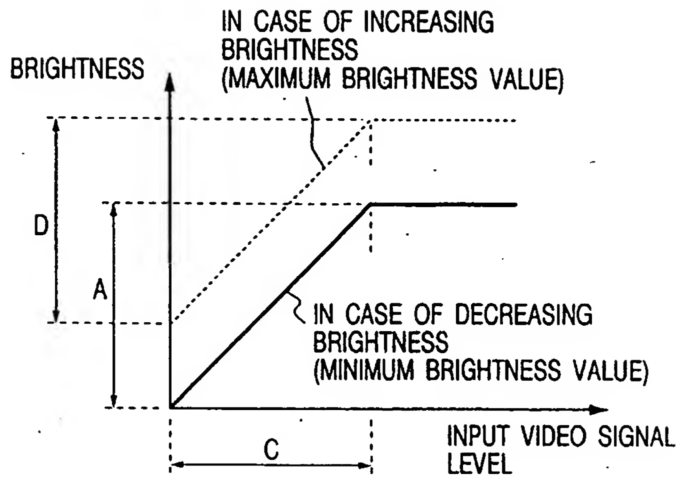

IN CASE OF INCREASING BRIGHTNESS (MAXIMUM BRIGHTNESS VALUE)
BRIGHTNESS
D
A
IN CASE OF DECREASING BRIGHTNESS (MINIMUM BRIGHTNESS VALUE)
C
INPUT VIDEO SIGNAL LEVEL

FIG. 10

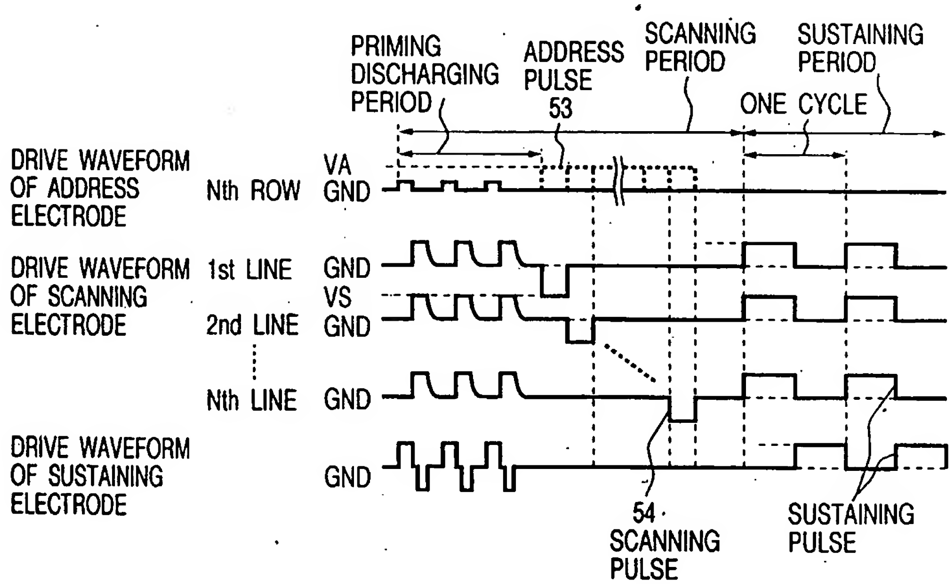
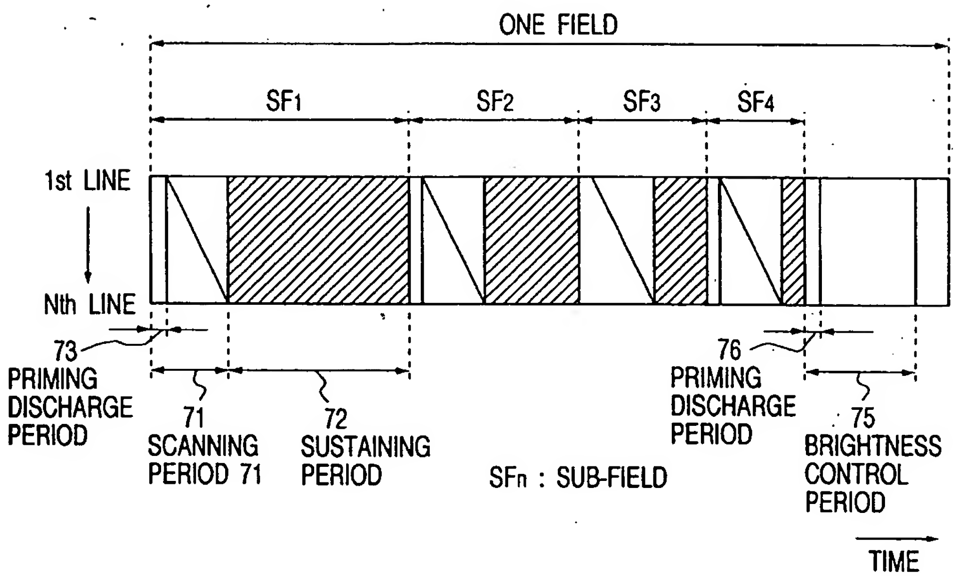

PRIMING DISCHARGING PERIOD
ADDRESS PULSE 53
SCANNING PERIOD
SUSTAINING PERIOD
ONE CYCLE
DRIVE WAVEFORM OF ADDRESS ELECTRODE
Nth ROW
VA
GND
DRIVE WAVEFORM OF SCANNING ELECTRODE
1st LINE
GND
VS
2nd LINE
GND
Nth LINE
GND
DRIVE WAVEFORM OF SUSTAINING ELECTRODE
GND
54
SCANNING PULSE
SUSTAINING PULSE

FIG. 11


ONE FIELD
SF1
SF2
SF3
SF4
1st LINE
Nth LINE
73
PRIMING DISCHARGE PERIOD
71
SCANNING PERIOD 71
72
SUSTAINING PERIOD
SFn : SUB-FIELD
76
PRIMING DISCHARGE PERIOD
75
BRIGHTNESS CONTROL PERIOD
TIME

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 10 8912

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP 0 657 861 A (FUJITSU) * column 11, line 9 - line 36; figures 4,5 *	1-13	G09G3/28
A	US 5 430 458 A (L.F. WEBER) * abstract * * column 3, line 27 - line 40 * * column 4, line 27 - line 40 *	1-5,8-13	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
G09G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 September 1997	O'Reilly, D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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